The problem of estimating the latent states of a dynamical system from observed data often arises in many branches of physical and social sciences, including image processing, navigation, econometrics, finance and meteorology. Filtering refers to any method for obtaining such state estimates, recursively in time, by combining model predictions with noisy observations. While the solution to the filtering problem for a linear dynamic system is well understood and has been studied extensively since 1960s, the optimal solution to the nonlinear filtering still poses challenging problems in maintaing a complete description of the conditional probability density. A number of suboptimal approximations, mainly based on Bayesian methods, have been proposed for solving the nonlinear filtering problem arising in different fields such as image processing, meteorology and econometrics, each offering an application-specific compromise between estimation accuracy, computational burden and numerical robustness. Because of the diversity of applications, researchers from different fields have developed both methodological and application specific innovations that often remain restricted to their respective fields. The purpose of this special issue on the mathematics of filtering and its applications is to collect experiences in filtering from different fields by including some papers, selected from the homonym workshop held at Brunel University in July 2011, which are representative of different application areas including financial mathematics, robotics and artificial intelligence. We are thankful to the editor Prof. V.J. Rayward-Smith for allocating a special issue dedicated to this topic.

The papers in this special issue address a wide range of research problems within this area. In particular, the application of an approximate inference procedure based on particle filtering has been proposed for solving tracking problems and to monitor moving objects in a scene by Cattelani et al. in the paper titled ‘A particle filtering approach for tracking an unknown number of objects with dynamic relations’. In ‘Single and Multi Camera Simultaneous Localization and Mapping using the Extended Kalman Filter on the different parameterizations for 3D point features’, Sorrenti et al. describe an application centered on a mobile observer using Extended Kalman filters, with interesting results in the area of robotics and intelligent transportation systems. The application of Bayesian filtering for hidden Markov models to a problem in financial asset allocation is considered in the paper titled ‘A higher-order Markov chain-modulated model for asset allocation’ by Mamon. Some theoretical aspects regarding the definition of a risk sensitive filter for solving optimal control problems have been addressed in ‘Generalised risk-sensitive control with full and partial state observation’ by Gashi and Date, while the same authors discuss the structural properties of a certain class of dynamic systems in ‘Controllability and controller-observer design for a class of linear time-varying systems’.

We would like to express our appreciation to the efforts of our reviewers, which helped shape this special issue.

Editors of the Special Issue
Paresh Date
Enza Messina